TDA7512

AM/FM car radio tuner IC with intelligent selectivity system (ISS)

Features

FM part

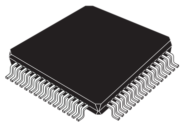
- RF AGC generation by RF and IF detection
- I/Q mixer for 1st FM IF 10.7 MHz with image rejection
- 2 programmable IF-gain stages
- Mixer for 2nd IF 450 kHz
- Internal 450 kHz bandpass filter with three bandwidths controlled by ISS
- Fully integrated FM-demodulator with noise cancellation

AM part

- Wide and narrow AGC generation
- Preamplifier and mixer for 1st IF 10.7 MHz, AM up conversion
- Mixer for 2nd IF 450 kHz
- Integrated AM demodulator
- Output for AM stereo decoder

Additional features

- VCO for world tuning range
- High performance fast PLL for RDS system
- IF counter for AM and FM with search stop signal
- Quality detector for level, deviation, adjacent channel and multi path



LQFP64 (10 x 10 x 1.4 mm)

- Quality detection informations as analog signals external available
- ISS (intelligent selectivity system) for cancellation of adjacent channel and noise influences
- Adjacent channel mute
- Fully electronic alignment
- All functions I^2C bus controlled
- ISS filter status information I^2C bus readable

Description

The TDA7512 is a high performance tuner circuit for AM/FM car radio. It contains mixer, IF amplifier, demodulator for AM and FM, quality detection, ISS filter and PLL synthesizer with IF counter on a single chip. Use of BiCMOS technology allows the implementation of several tuning functions and a minimum of external components.

Table 1. Device summary

Order code	Package	Packing
E-TDA7512	LQFP64	Tray

Contents

1 Block diagram 6

2 Pin description 7

3 Electrical specifications 10

3.1 Absolute maximum ratings 10

3.2 Thermal data 10

3.3 Electrical characteristics 10

3.4 Electrical characteristics (with f_{RF}, f_{MOD} in different conditions) 16

3.5 Electrical characteristics (additional parameters) 17

4 Functional description 19

4.1 FM section 19

4.1.1 Mixer1, AGC and 1.IF 19

4.1.2 Mixer2, limiter and demodulator 19

4.1.3 Quality detection and ISS 19

4.1.4 Soft mute control 20

4.2 AM section 21

4.3 PLL and IF counter section 21

4.3.1 PLL frequency synthesizer block 21

4.3.2 Frequency generation for phase comparison 22

4.3.3 Three state phase comparator 22

4.3.4 Charge pump current generator 22

4.3.5 Inlock detector 22

4.3.6 Low noise CMOS Op-amp 22

4.3.7 IF counter block 22

4.3.8 The IF-counter mode 23

4.3.9 Sampling timer 23

4.3.10 Intermediate frequency main counter 23

4.3.11 Adjustment of the measurement sequence time 23

4.3.12 Adjust of the frequency value 24

4.4 I^2C bus interface 24

4.4.1 Data transition 24

4.4.2 Start condition 24

4.4.3 Stop condition 24
4.4.4 Acknowledge 24
4.4.5 Data transfer 24
4.4.6 Device addressing 24
4.4.7 Write operation 25
4.4.8 Read operation 25

5 Software specification 26
5.1 Address organization 26
5.2 Control register function 27
5.3 Data byte specification 30

6 Package information 42

Appendix A Block diagrams 43

Appendix B Application notes 47

7 Revision history 48

List of tables

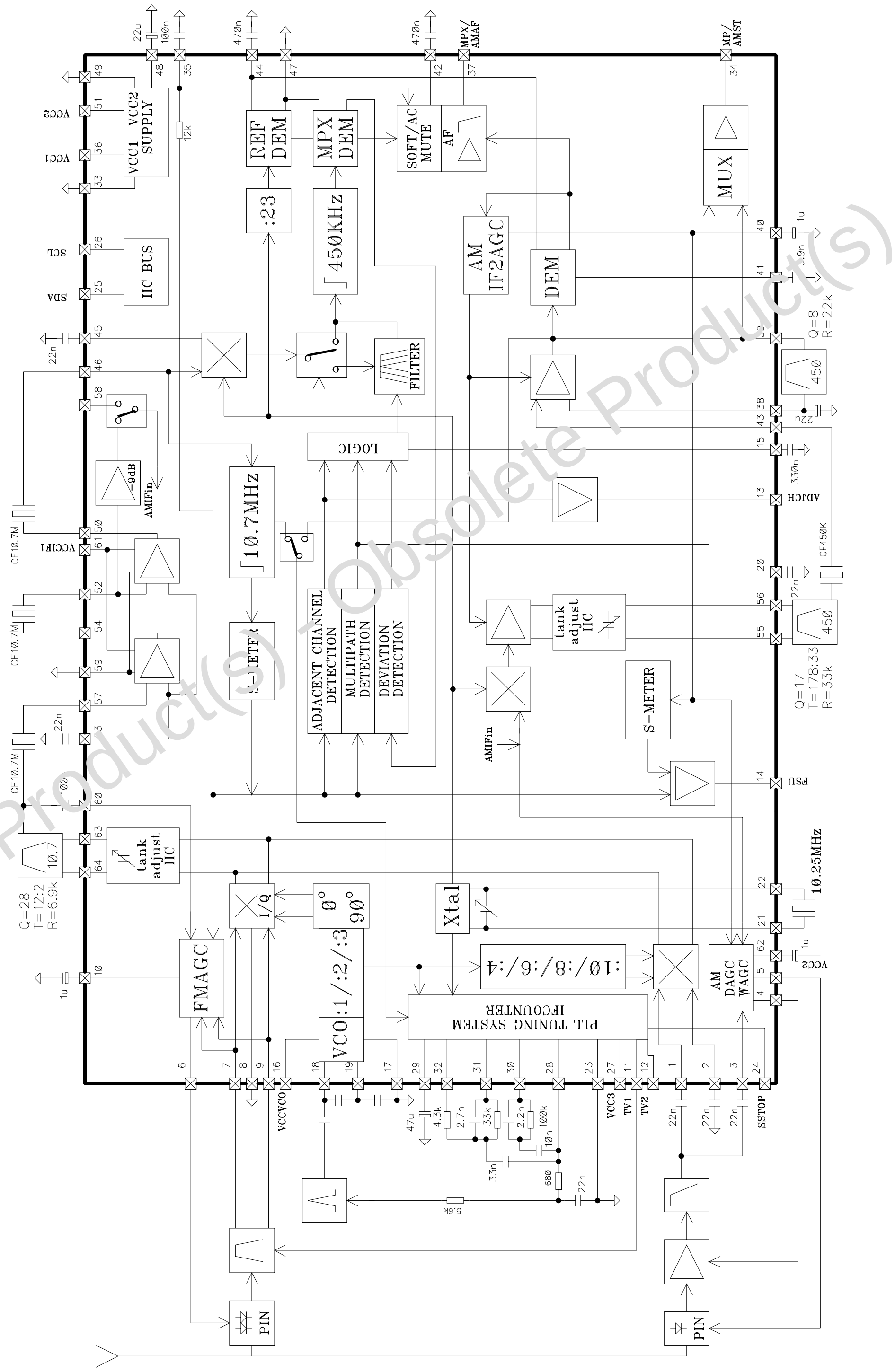
Table 1. Device summary 1
Table 2. Pin description 7
Table 3. Absolute maximum ratings 10
Table 4. Thermal data 10
Table 5. Electrical characteristics 10
Table 6. Electrical characteristics (with f_{RF}, f_{MOD} in different conditions) 16
Table 7. Electrical characteristics (additional parameters) 17
Table 8. Address organization 26
Table 9. Control register function 27
Table 10. Subaddress 29
Table 11. Addr 0 charge pump control 30
Table 12. Addr 1 PLL counter 1 (LSB) 30
Table 13. Addr 2 PLL counter 2 (MSB) 31
Table 14. Addr 3,4 TV1,2 (offset referred to tuning voltage PIN28) 31
Table 15. Addr 5 IF counter control 1 32
Table 16. Addr 6 IF counter control 2 32
Table 17. Addr 7 AM control 33
Table 18. Addr 8 quality ISS filter 33
Table 19. Addr 9 quality detection adjacent channel 34
Table 20. Addr 10 quality detection multipath 34
Table 21. Addr 11 quality deviation detection 35
Table 22. Addr 12 softmute control 1 36
Table 23. Addr 13 softmute control 2 36
Table 24. Addr 14 VCODIV/PLLREF 37
Table 25. Addr 15 FM AGC 37
Table 26. Addr 16 AM AGC 38
Table 27. Addr 17 FM demodulator fine adjust 39
Table 28. Addr 18 S-meter slider 39
Table 29. Addr 19 IF GAIN/Crystal adjust 40
Table 30. Addr 20 tank adjust 40
Table 31. Addr 21 I/Q FM mixer1 adjust 41
Table 32. Addr 22 test control 1 41
Table 33. Addr 23 test control 2 41
Table 34. Addr 24 Test Control 3 41
Table 35. Addr 25 test control 4 41
Table 36. Block diagram quality detection principle (without overdeviation correction) 45
Table 37. Input signals modes 45
Table 38. Part list (application and measurement circuit) 45
Table 39. Document revision history 48

List of figures

Figure 1. Block diagram 6
Figure 2. Pin connection (top view) 7
Figure 3. Software specification 26
Figure 4. LQFP64 mechanical data and package dimensions 42
Figure 5. Block diagram I/Q mixer 43
Figure 6. Block diagram VCO 43
Figure 7. Block diagram keying AGC 44
Figure 8. Block diagram ISS function 44
Figure 9. Application circuit 46

1 Block diagram

Figure 1. Block diagram



2 Pin description

Figure 2. Pin connection (top view)

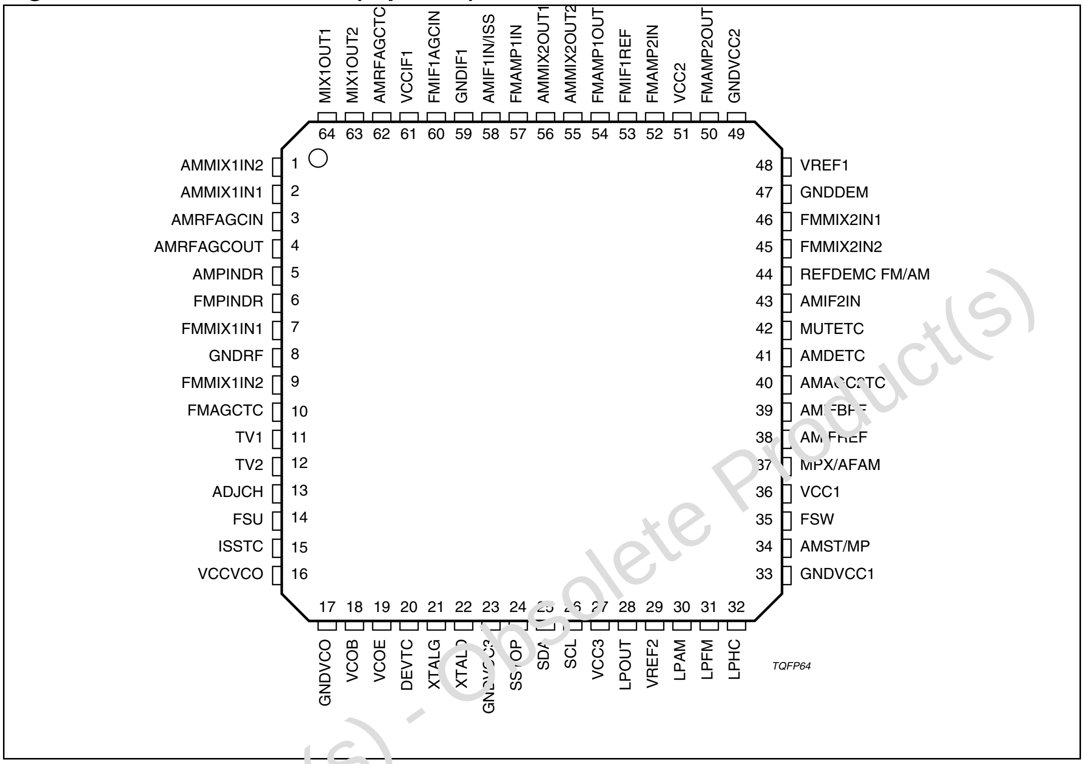


Table 2. Pin description

N°	Pin name	Function
1	AMMIX1IN2	AM Input2 Mixer1
2	AMMIX1IN1	AM Input1 Mixer1
3	AMRFAGCIN	Input AM RF AGC
4	AMRFAGCOUT	Output AM RF AGC
5	AMPINDR	AM PIN diode driver output
6	FMPINDR	FM PIN diode driver output
7	FMMIX1IN1	FM input1 mixer1
8	GNDRF	RF ground
9	FMMIX1IN2	FM input2 mixer1
10	FMAGCTC	FM AGC time constant
11	TV1	Tuning voltage preselection1
12	TV2	Tuning voltage preselection2
13	ADJCH	Ident. adjacent channel output
14	FSU	Unweighted Fieldstrength output

Table 2. Pin description (continued)

N°	Pin name	Function
15	ISSTC	Time constant for ISS filter switch
16	VCCVCO	VCO supply
17	GNDVCO	VCO ground
18	VCOB	VCO input base
19	VCOE	VCO output emitter
20	DEVTC	Deviation detector time constant
21	XTALG	Crystal oscillator to MOS gate
22	XTALD	Crystal oscillator to MOS drain
23	GNDVCC3	VCC3 ground
24	SSTOP	Search stop output
25	SDA	I^2C bus data
26	SCL	I^2C bus clock
27	VCC3	Supply tuning voltage
28	LPOUT	Op. amp. output to PLL loop filters
29	VREF2	Voltage reference for PLL op. amp.
30	LPAM	Op. amp. input to PLL loop filters AM
31	LPFM	Op. amp. input to PLL loop filters FM
32	LPHC	High current PLL loop filter input
33	GNDVCC1	Digital ground
34	AMST/MP	AM stereo out / ident. multipath output
35	FSW	Weighted Fieldstrength output
36	VCC1	Digital supply
37	MPX/AFAM	MPX output / AM AF output
38	AMIFREF	Reference voltage AM IF amp.
39	AMIFBPF	AM IF filter
40	AMAGC2TC	AM AGC2 time constant
41	AMDETC	AM detector capacitor
42	MUTETC	Softmute time constant
43	AMIF2IN	Input AM IF2
44	REFDEMC FM/AM	Demodulator reference FM/AM
45	FMMIX2IN2	FM IF1 MIX2 input1
46	FMMIX2IN1	FM IF1 MIX2 input2
47	GNDDEM	Ground FM demodulator
48	VREF1	Reference 5V

Table 2. Pin description (continued)

N°	Pin name	Function
49	GNDVCC2	Analog ground
50	FMAMP2OUT	FM IF1 amplifier2 output
51	VCC2	Analog supply
52	FMAMP2IN	FM IF1 amplifier2 input
53	FMIF1REF	FM IF1 amplifier reference
54	FMAMP1OUT	FM IF1 amplifier1 output
55	AMMIX2OUT2	AM tank 450 kHz
56	AMMIX2OUT1	AM tank 450 kHz
57	FMAMP1IN	FM IF1 amplifier1 Input
58	AMIF1IN/ISS	AM IF1 input/ISS filter status
59	GNDIF1	FM IF1 ground
60	FMIF1AGCIN	FM IF1 AGC input
61	VCCIF1	IF1 supply
62	AMRFAGCTC	AM RF AGC Time constant
63	MIX1OUT2	MIX tank 10.7 MHz
64	MIX1OUT1	MIX tank 10.7 MHz

3 Electrical specifications

3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_S	Supply voltage	10.5	V
T_{amb}	Ambient temperature	-40 to 85	°C
T_{stg}	Storage temperature	-55 to +150	°C

3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Value	Unit
$R_{th(j\text{-}amb)}$	Thermal resistance junction to ambient	68 max.	°C/W

3.3 Electrical characteristics

T_{amb} = +25 °C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCVCO} = V_{CCMIX1} = V_{CCIF1} = 8.5 V, f_{RF} = 98 MHz, dev. = 40 kHz, f_{MOD} = 1 kHz, f_{IF1} = 10.7 MHz, f_{IF2} = 450 kHz, $f_{crystal}$ = 10.25 MHz, in application circuit, unless otherwise specified.

Table 5. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Supply						
V_{CC1}	Digital supply voltage	-	7.5	8.5	10	V
V_{CC2}	Analog supply voltage	-	7.5	8.5	10	V
V_{CC3}	Analog tuning voltage	-	7.5	8.5	10	V
V_{CCVCO}	VCO supply voltage	-	7.5	8.5	10	V
V_{CCMIX1}	MIX1 supply voltage	-	7.5	8.5	10	V
V_{CCMIX2}	MIX2 supply voltage	-	7.5	8.5	10	V
V_{CCIF1}	IF1 supply voltage	-	7.5	8.5	10	V
I_{CC1}	Supply current	FM ON	-	7.5	-	mA
I_{CC1}	Supply current	AM ON	-	10	-	mA
I_{CC2}	Supply current	FM ON / VCO:3	-	70	-	mA
I_{CC2}	Supply current	AM ON	-	70	-	mA
I_{CC3}	Supply current	-	-	2	-	mA
I_{CCVCO}	Supply current	-	-	9	-	mA

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{CCMIX1}	Supply current	FM ON	-	8	-	mA
I_{CCMIX1}	Supply current	AM ON	-	7	-	mA
I_{CCMIX2}	Supply current	AM ON	-	7	-	mA
I_{CCIF1}	Supply current	-	-	6	-	mA
Reference voltages						
V_{REF1}	Internal reference voltage	I_{REF1} = 0 mA	-	5	-	V
V_{REF2}	Internal reference voltage	I_{REF2} = 0 mA	-	2.5	-	V
Wide band RF AGC						
V_{7-9}	Lower threshold start	V_{10} = 2.5 V	-	85	-	dBµV
V_{7-9}	Upper threshold start	V_{10} = 2.5 V	-	96	-	dBµV
Narrow band IF & Keying AGC						
V_{60}	Lower threshold start	KAGC = off, V_{7-9} = 0 mV_{RMS}	-	86	-	dBµV
V_{60}	Upper threshold start	KAGC = off, V_{7-9} = 0 mV_{RMS}	-	98	-	dBµV
V_{60}	Lower threshold start with KAGC	KAGC = max, V_{7-9} = 0 mV_{RMS}, Δf_{IF}=300 kHz	-	98	-	dBµV
V_{35}	Startpoint KAGC	KAGC = max, V_{7-9} = 0 mV_{RMS}, Δf_{IF}=300 kHz f_{IF1} generate FSW level at V_{35}	-	3.6	-	V
D	Control range KAGC	ΔV_{35}= +0.4V	-	16	-	dB
R_{IN}	Input resistance	-	-	10	-	kΩ
C_{IN}	Input capacitance	-	-	2.5	-	pF
AGC time constant output						
V_{10}	Max. AGC output voltage	V_{7-9} = 0 mV_{RMS}	-	-	V_{REF1} +V_{BE}	V
V_{10}	Min. AGC output voltage	V_{7-9} = 50 mV_{RMS}	-	-	0.5	V
I_{10}	Min. AGC charge current	V_{7-9} = 0 mV_{RMS},V_{10} = 2.5 V	-	-12.5	-	µA
I_{10}	Max. AGC discharge current	V_{7-9} = 50 mV_{RMS},V_{10} = 2.5 V	-	1.25	-	mA
AGC pin diode driver output						
I_6	AGC OUT, current min.	V_{7-9} = 0 mV_{RMS}, V_6 = 2.5 V	-	50	-	µA
I_6	AGC OUT, current max.	V_{7-9} = 50 mV_{RMS}, V_6 = 2.5 V	-	-20	-	mA
I/Q Mixer1 (10.7 MHz)						
R_{IN}	Input resistance	differential	-	10	-	kΩ
C_{IN}	Input capacitance	differential	-	4	-	pF
R_{OUT}	Output resistance	differential	100	-	-	kΩ

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{7,9}$	Input dc bias	-	-	3.2	-	V
g_m	Conversion transconductance	-	-	17	-	mS
F	Noise figure	400Ω generator resistance	-	3	-	dB
CP_{1dB}	1 dB compression point	referred to diff. mixer input	-	100	-	dBµV
IIP3	3rd order intermodulation	-	-	122	-	dBµV
IQG	I/Q gain adjust	G	-1	-	+1	%
IQP	I/Q phase adjust	PH	-7	-	+8	°
IRR	Image rejection ratio	ratio wanted/image	30	40	-	dB
IRR	Image rejection ratio	with gain and phase adjust	40	46	-	dB
IF1 Amplifier1 +2 (10.7 MHz)						
G_{min}	Min. gain	IFG	-	18	-	dB
G_{max}	Max. gain	IFG	-	26	-	dB
R_{IN}	Input resistance	-	-	330	-	Ω
R_{OUT}	Output resistance	-	-	330	-	Ω
CP_{1dB}	1 dB compression point	referred to 330Ω input	-	105	-	dBµV
IIP3	3rd order Intermodulation	referred to 330Ω input	-	126	-	dBµV
Mixer2 (450 kHz)						
R_{IN}	Input impedance	-	-	330	-	W
V_{46}	Max. input voltage	-	-	900	-	mV_{RMS}
V_{48}	Limiting sensitivity	S/N = 20 dB	-	25	-	µV
G	Mixer gain	-	-	18	-	dB
Limiter 1 (450 kHz)						
$G_{Limiter}$	Gain	-	-	80	-	dB
Demodulator, audio output						
THD		Dev.= 75 kHz, V_{46} = 10 mV_{RMS}	-	-	0.1	%
V_{MPX}	MPX output signal	Dev.= 75 kHz	-	500	-	mV_{RMS}
R_{OUT}	Output resistance	-	-	50	-	W
$\|\Delta V\|_{min}$	DC offset fine adjust	DEM, MENA=1	-	8.5	-	mV
$\|\Delta V\|_{max}$	DC offset fine adjust	DEM, MENA=1	-	264	-	mV
S/N		Dev.= 40 kHz,V_{46} = 10 mV_{RMS}	-	76	-	dB
QUALITY DETECTION						
S-meter, unweighted Fieldstrength						
V_{46}	Min. input voltage MIX2	-	-	10	-	µV

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_{14}	Fieldstrength output	$V_{46} = 0V_{RMS}$	-	0.1	-	V
V_{14}	Fieldstrength output	$V_{46} = 1V_{RMS}$	-	4.9	-	V
ΔV_{14}	voltage per decade	SMSL = 0	-	1	-	V
ΔV_{14}	voltage per decade	SMSL = 1	-	1.5	-	V
ΔV_{14}	S-meter offset	SL, SMSL=1	-15		15	dB
R_{OUT}	Output resistance	-	-	200	-	Ω
TK	Temp coeff.	-	-	0	-	ppm/K
S-meter, weighted Fieldstrength						
V_{35}	Fieldstrength output	$V_{46} = 0V_{RMS}$	-	2.5	-	V
V_{35}	Fieldstrength output	$V_{46} = 1V_{RMS}$	-	4.9	-	V
R_{OUT}	Output resistance	-	-	12	-	kΩ
Adjacent Channel Gain						
G_{min}	Gain minimum	ACG=0	-	32	-	dB
G_{max}	Gain maximum	ACG=1	-	38	-	dB
Adjacent channel filter						
f_{HP}	-3 dB frequency highpass	ACF=0	-	100	-	kHz
f_{BP}	Centre frequency	ACF=1	-	100	-	kHz
f_{-20dB}	Attenuation 20 dB		-	70	-	kHz
Adjacent channel output						
V_{13}	Output voltage low	-	-	0.1	-	V
V_{13}	Output voltage high	-	-	4.9	-	V
R_{OUT}	Output resistance	-	-	4	-	kΩ
Multipath channel gain						
G_{min}	Gain minimum	MPG=0	-	12	-	dB
G_{max}	Gain maximum	MPG=1	-	23	-	dB
Multipath bandpass filter						
f_{Lower}	Centre frequency low	MPF=0	-	19	-	kHz
f_{Upper}	Centre frequency up	MPF=1	-	31	-	kHz
Q	Quality factor	-	5	-	10	-
Multipath output						
V_{34}	Output voltage low	-	-	0.1	-	V
V_{34}	Output voltage high	-	-	4.9	-	V
R_{OUT}	Output resistance	-	-	2.5	-	kΩ

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
ISS (intelligent Selectivity System)						
Filter 450 kHz						
f_{centre}	Centre frequency	f_{REF_intern} = 450 kHz	-	450	-	kHz
BW 3 dB	Bandwidth, -3 dB	ISS80 = 1	-	80	-	kHz
BW 20 dB	Bandwidth, -20 dB	ISS80 = 1	-	150	-	kHz
BW 3 dB	Bandwidth, -3 dB	ISS80 = 0	-	120	-	kHz
BW 20 dB	Bandwidth, -20 dB	ISS80 = 0	-	250	-	kHz
BW 3 dB	Bandwidth weather band	ISS30 = 1	-	30	-	kHz
BW 20 dB	-20 dB weather band	ISS30 = 1	-	80	-	kHz
Adjacent channel ISS filter threshold						
V_{NTH}	Internal low threshold	ACNTH	-	0	-	V
V_{NTH}	Internal high threshold	ACNTH	-	0.3	-	V
V_{WTH}	Internal low threshold	ACWTH	-	0.25	-	V
V_{WTH}	Internal high threshold	ACWTH	-	0.95	-	V
Multipath threshold						
V_{THMP}	Internal low threshold	MPTH	-	0.50	-	V
V_{THMP}	Internal high threshold	MPTH	-	1.25	-	V
ISS filter time constant						
I_{15}	Charge current low mid	TISS, ISSCTL = 1	-	-74	-	µA
I_{15}	Charge current high mid	TISS, ISSCTL = 1	-	-60	-	µA
I_{15}	Charge current low narrow	TISS, ISSCTL = 1	-	-124	-	µA
I_{15}	Charge current high narrow	TISS, ISSCTL = 1	-	-110	-	µA
I_{15}	Discharge current low	TISS, ISSCTL = 0	-	1	-	µA
I_{15}	Discharge current high	TISS, ISSCTL = 0	-	15	-	µA
V_{15}	Low voltage	ISSCTL = 0	-	0.1	-	V
V_{15}	High voltage	ISSCTL = 1	-	4.9	-	V
ISS filter switch threshold						
V_{15}	Threshold ISS on	ISSCTL = 0	-	3	-	V
V_{15}	Threshold ISS off	ISSCTL = 0	-	1	-	V
V_{15}	Threshold ISS narrow on	ISSCTL = 0	-	4	-	V
V_{15}	Threshold ISS narrow off	ISSCTL = 0	-	2	-	V
I_{20}	Charge current low	TDEV	-	-20	-	µA
I_{20}	Charge current high	TDEV	-	-34	-	µA

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{20}	Discharge current low	TDEV	-	6	-	µA
I_{20}	Discharge current high	TDEV	-	20	-	µA
DEV_{WTH}	Internal low threshold	DWTH	-	30	-	kHz
DEV_{WTH}	Internal high threshold	DWTH	-	75	-	kHz
$RATIO_{min}$	Referred to threshold	DTH	-	1	-	-
$RATIO_{max}$	Referred to threshold	DTH	-	1.5	-	-
Softmute						
V_{ANT}	Upper startpoint	SMTH, SMD, SLOPE = 0	-	10	-	dBµV
V_{ANT}	lower startpoint	SMTH, SMD, SLOPE = 0	-	3	-	dBµV
a_{SMmin}	Min. softmute depth	SMD, SLOPE = 0, $SMTH_{Upper}$	-	15	-	dB
a_{SMmax}	Max. softmute depth	SMD, SLOPE = 0, $SMTH_{Upper}$	-	36	-	dB
$a_{SMTHISS}$	Mute depth threshold for ISS filter on	SMCTH	0.2	-	2	dB
V_{ACTH}	Internal AC mute threshold	ACM	60	-	340	mV
a_{SMAC}	AC mute depth	ACMD	4	-	10	dB
I_{42}	Charge current	-	-	-47.5	-	µA
I_{42}	Discharge current	-	-	2.5	-	µA
S/N over all						
S/N	Signal to noise ratio	V_{ANT_min} = 60 dBµV, dev.= 40 kHz,LP=15 kHz de-emphasis t = 50 µs	66	-	-	dB

3.4 Electrical characteristics (with f_{RF}, f_{MOD} in different conditions)

T_{amb} = +25 °C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = 8.5 V, f_{RF} = 1 MHz, f_{MOD} = 400 Hz at 30 % AM f_{IF1} = 10.7 MHz, f_{IF2} = 450 kHz, $f_{crystal}$ = 10.25 MHz, in application circuit, (unless otherwise noted, V_{INRF} antenna input).

Table 6. Electrical characteristics (with f_{RF}, f_{MOD} in different conditions)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Global						
V_{ANT} min	Max. sensitivity	Ref.: V_{INRF} = 60 dBµV,	-	19	-	dBµV
V_{ANT} us	Usable sensitivity	(S+N)/N = 20 dB	30	26	-	dBµV
ΔV_{ANT}	IF2 AGC Range	Ref.: V_{INRF} = 60 dBµV,	56	-	-	dB
(S+N)/N	Signal to Noise Ratio	Ref.: V_{INRF} = 60 dBµV	50	60	-	dB
a_{IF}	IF rejection	Ref: V_{INRF} = 60 dBµV, IF1 = 10.7 MHz IF2 = 450 kHz	 100 100	-	-	 dB dB
f_{AF}	Frequency response	Ref.: V_{INRF} = 60 dBµV, ΔV_{AF} = -3 dB	-	3.6	-	kHz
THD	Total Harmonic Distortion	V_{INRF} = 60 dBµV, m = 0.8 m = 0.3 V_{INRF} = 120 dBµV, m = 0.8 m = 0.3	-	0.5 0.3 1.0 0.3	-	%
V_{37}	Output level	V_{INRF} = 60 dBµV	-	220	-	mV_{RMS}
V_{34}	Output level	V_{INRF} = 60 dBµV, m=off	-	190	-	mV_{RMS}
V_3	Min. RF AGC threshold Max. RF AGC threshold	WAGC	-	90 109	-	dBµV
V_{58}	Min. IF AGC threshold Max. IF AGC threshold	WAGC	-	90 109	-	dBµV
V_{58}	Min. DAGC threshold Max. DAGC threshold	DAGC	-	74 96	-	dBµV
$\lvert I_{40max} \rvert$	AGC2 charge current	seek	-	160	-	µA
CCR	Charge current ratio	seek/seek off	-	30	-	-
AGC voltage driver output						
V_4	Max. AGC output voltage	-	3.5		-	V
V_4	Min. AGC output voltage	-	-		0.5	V
$\lvert I_4 \rvert$	AGC current	-	-	100	-	µA
AGC pin diode driver output						
I_5	AGC driver current	-	-	-2	-	mA

Table 6. Electrical characteristics (with f_{RF}, f_{MOD} in different conditions) (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
AM Mixer1 (10.7 MHz)						
R_{IN}	Input resistance	differential	-	1.2	-	kΩ
C_{IN}	Input capacitance	differential	-	4	-	pF
R_{OUT}	Output impedance	differential	100		-	kΩ
CP_{1dB}	1 dB compression point	referred to diff. mixer input	-	115	-	dBμV
IIP3	3rd order intermodulation	-	-	132	-	dBμV
F	Noise figure	-	-	8	-	dB
A	Gain	-	-	26	-	dB
C_{min}	Min. capacitance step	IF1T	-	0.55	-	pF
C_{max}	Max. capacitance	IF1T	-	8.25	-	pF
C_{31-64}		IF1T	-	2	-	pF
AM Mixer2 (450 kHz)						
R_{58}	Input resistance	-	-	10	-	kΩ
C_{58}	Input capacitance	-	-	2.5	-	pF
CP_{1dB}	1 dB compression point	referred to diff. mixer input	-	120	-	dBμV
IIP3	3rd order intermodulation	-	-	132	-	dBμV
F	Noise figure	-	-	12	-	dB
A	Max. gain	Mixer2 tank output	-	34	-	dB
ΔA	Gain control range	-	-	20	-	dB
C_{min}	Min. cap step	IF2T	-	1.6	-	pF
C_{max}	Max. cap	IF2T	-	24	-	pF
C_{55-56}		IF2T	-	2	-	pF

3.5 Electrical characteristics (additional parameters)

Table 7. Electrical characteristics (additional parameters)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
Output of tuning voltages (TV1,TV2)						
V_{OUT}	Output voltage	TVO	0.5	-	V_{CC3}-0.5	V
R_{OUT}	Output impedance	-	-	20	-	kΩ
Crystal reference oscillator						
f_{LO}	Reference frequency	C_{Load} = 15 pF	-	10.25	-	MHz
C_{Step}	Min. cap step	Crystal	-	0.75	-	pF

Table 7. Electrical characteristics (additional parameters) (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{max}	Max. cap	Crystal	-	23.25	-	pF
$\Delta f/f$	Deviation versus VCC2	ΔV_{CC2} = 1 V	-	1.5	-	ppm/V
$\Delta f/f$	Deviation versus temp	-40°C < T < +85°C	-	0.2	-	ppm/K
I^2C bus interface						
f_{SCL}	Clock frequency	-	-	-	400	kHz
V_{IL}	Input low voltage	-	-	-	1	V
V_{IH}	Input high voltage	-	3	-		V
I_{IN}	Input current	-	-5	-	5	μA
V_O	Output acknowledge voltage	I_O = 1.6 mA	-	-	0.4	V
Loop filter input/output						
$-I_{IN}$	Input leakage current	V_{IN} = GND, PD_{OUT} = Tristate	-0.1	-	0.1	μA
I_{IN}	Input leakage current	V_{IN} = VREF1 PD_{OUT} = Tristate	-0.1	-	0.1	μA
V_{OL}	Output voltage Low	I_{OUT} = -0.2 mA	-	0.05	0.5	V
V_{OH}	Output voltage High	I_{OUT} = 0.2 mA	V_{CC3}-0.5	V_{CC3}-0.05	-	V
I_{OUT}	Output current, sink	V_{OUT} = 1 V to V_{CC3}-1 V	-	-	10	mA
I_{OUT}	Output current, source	V_{OUT} = 1 V to V_{CC3}-1 V	-10	-	-	mA
Voltage controlled oscillator (VCO)						
f_{VCOmin}	Minimum VCO frequency	-	50	-	-	MHz
f_{VCOmax}	Maximum VCO frequency	-	-	-	260	MHz
C/N	Carrier to Noise	f_{VCO}= 200 MHz, Δf=1 kHz, B=1 Hz, closed loop	-	80	-	dBc
SSTOP output (open collector)						
V_{24}	Output voltage low	I_{24} = -200 μA	-	0.2	0.5	V
V_{24}	Output voltage high	-	-	-	5	V
$-I_{24}$	Output leakage current	V_{24} = 5 V	-0.1	-	0.1	μA
I_{24}	Output current, sink	V_{24} = 0.5 V to 5 V	-	-	1	mA

4 Functional description

4.1 FM section

4.1.1 Mixer1, AGC and 1.IF

FM quadrature I/Q-mixer converts FM RF to IF1 of 10.7 MHz. The mixer provides inherent image rejection and wide dynamic range with low noise and large input signal performance. The mixer1 tank can be adjusted by software (IF1T). For accurate image rejection the gain- and phase-error generated as well in mixer as VCO stage can be compensated by software (G,PH)

It is capable of tuning the US FM, US weather, Europe FM, Japan FM and East Europe FM bands

- US FM = 87.9 to 107.9 MHz
- US weather = 162.4 to 162.55 MHz
- Europe FM = 87.5 to 108 MHz
- Japan FM = 76 to 91 MHz
- East Europe FM = 65.8 to 74 MHz

The AGC operates on different sensitivities and bandwidths in order to improve the input sensitivity and dynamic range. AGC thresholds are programmable by software (RFAGC,IFAGC,KAGC). The output signal is a controlled current for double pin diode attenuator.

Two 10.7 MHz programmable amplifiers (IFG1, IFG2) correct the IF ceramic insertion loss and the costumer level plan application.

4.1.2 Mixer2, limiter and demodulator

In this 2. mixer stage the first 10.7 MHz IF is converted into the second 450 kHz IF. A multi-stage limiter generates signals for the complete integrated demodulator without external tank. MPX output DC offset versus noise DC level is correctable by software (DEM).

4.1.3 Quality detection and ISS

Fieldstrength

Parallel to mixer2 input a 10.7 MHz limiter generates a signal for digital IF counter and a fieldstrength output signal. This internal unweighted fieldstrength is used for keying AGC, adjacent channel and multipath detection and is available at PIN14 (FSU) after +6 dB buffer stage. The behavior of this output signal can be corrected for DC offset (SL) and slope (SMSL). The internal generated unweighted fieldstrength is filtered at PIN35 and used for softmute function and generation of ISS filter switching signal for weak input level (sm).

Adjacent channel detector

The input of the adjacent channel detector is AC coupled from internal unweighted fieldstrength. A programmable highpass or bandpass (ACF) and amplifier (ACG) as well as rectifier determines the influences. This voltage is compared with adjustable comparator1 thresholds (ACWTH, ACNTH). The output signal of this comparator generates a DC level at PIN15 by programmable time constant. Time control (TISS) for a present adjacent channel is made by charge and discharge current after comparator1 in an external capacitance. The charge current is fixed and the discharge current is controlled by I^2C Bus. This level produces digital signals (ac, ac+) in an additional comparator4. The adjacent channel information is available as analog output signal after rectifier and +8 dB output buffer.

Multipath detector

The input of the multipath detector is AC coupled from internal unweighted fieldstrength. A programmable bandpass (MPF) and amplifier (MPG) as well as rectifier determines the influences. This voltage is compared with an adjustable comparator2 thresholds (MPTH). The output signal of this comparator2 is used for the "Milano" effect. In this case the adjacent channel detection is switched off. The "Milano" effect is selectable by I^2C bus (MPOFF). The multipath information is available as analog output signal after rectifier and +8 dB output buffer.

450 kHz IF narrow bandpass filter (ISS filter)

The device gets an additional second IF narrow bandpass filter for suppression of noise and adjacent channel signal influences. This narrow filter has three switchable bandwidths, narrow range of 80 kHz, mid range of 120 kHz and 30 kHz for weather band information. Without ISS filter the IF bandwidth (wide range) is defined only by ceramic filter chain. The filter is switched in after mixer2 before 450 kHz limiter stage. The centre frequency is matching to the demodulator center frequency.

Deviation detector

In order to avoid distortion in audio output signal the narrow ISS filter is switched OFF for present overdeviation. Hence the demodulator output signal is detected. A lowpass filtering and peak rectifier generates a signal that is defined by software controlled current (TDEV) in an external capacitance. This value is compared with a programmable comparator3 thresholds (DWTH, DTH) and generates two digital signals (dev, dev+). For weak signal condition deviation threshold is proportional to FSU.

ISS switch logic

All digital signals coming from adjacent channel detector, deviation detector and softmute are acting via switching matrix on ISS filter switch. The IF bandpass switch mode is controlled by software (ISSON, ISS30, ISS80, CTLOFF). The switch ON of the IF bandpass is also available by external manipulation of the voltage at PIN15. Two application modes are available (APPM). The conditions are described in *Table 5*.

4.1.4 Soft mute control

The external fieldstrength signal at PIN35 is the reference for mute control. The startpoint and mute depth are programmable (SMTH, SMD) in a wide range. The time constant is defined by external capacitance. Additional adjacent channel mute function is supported. A highpass filter with -3 dB threshold frequency of 100 kHz, amplifier and peak rectifier generates an adjacent noise signal from MPX output with the same time constant for softmute. This value is compared with comparator 5 thresholds (ACM). For present strong adjacent channel the MPX signal is additional attenuated (ACMD).

4.2 AM section

The up/down conversion is combined with gain control circuit sensing three input signals, narrow band information at PIN39, up conversion signal (IFAGC) at PIN58 and wide band information (RFAGC) at PIN3.This gain control gives two output signals. The first one is a current for pin diode attenuator and the second one is a voltage for preamplifier. Time constant of RF- and IF-AGC is defined by internal 100k resistor and external capacitor at PIN 62. The intervention points for AGC (DAGC,WAGC) are programmable by software. In order to avoid a misbehavior of AGC intervention point it is important to know that the DAGC threshold has to be lower than WAGC threshold!

The oscillator frequency for upconcersion-mixer1 is generated by dividing the FM VCO frequency after VCO (VCOD) and AM predivider (AMD). It is possible to put in a separate narrow bandpass filter before mixer2 at PIN58. In this case input P58 needs the DC-operation point from PIN53 via resistance matched with filter impedance. Additional it is possible to use second 10,7 MHz ceramic filter by internal switch between mixer2 input and PIN 52. This feature increases 900 kHz attenuation.

In mixer2 the IF1 is down converted into the IF2 450 kHz. After filtering by ceramic filter a 450 kHz amplifier is included with an additional gain control of IF2 below DAGC threshold. Time constant is defined by capacitance at PIN40

Mixer1 and mixer2 tanks are software controlled adjustable (IF1T, IF2T).

The demodulator is a peak detector to generate the audio output signal.

A separate output is available for AMIF stereo (AMST).

4.3 PLL and IF counter section

4.3.1 PLL frequency synthesizer block

This part contains a frequency synthesizer and a loop filter for the radio tuning system. Only one VCO is required to build a complete PLL system for FM world tuning and AM up conversion. For auto search stop operation an IF counter system is available.

The counter works in a two stages configuration. The first stage is a swallow counter with a two modulus (32/33) pre counter. The second stage is an 11-bit programmable counter.

The circuit receives the scaling factors for the programmable counters and the values of the reference frequencies via an I^2C bus interface.The reference frequency is generated by an adjustable internal (Crystal) oscillator followed by the reference divider. The main reference and step-frequencies are free selectable (RC, PC).

Output signals of the phase detector are switching the programmable current sources. The loop filter integrates their currents to a DC voltage.

The values of the current sources are programmable by 6 bits also received via the I^2C bus (A, B, CURRH, LPF).

To minimize the noise induced by the digital part of the system, a special guard configuration is implemented.

The loop gain can be set for different conditions by setting the current values of the charge pump generator.

4.3.2 Frequency generation for phase comparison

The RF signals applies a two modulus counter (32/33) pre-scaler, which is controlled by a 5-bit A-divider. The 5-bit register (PC0 to PC4) controls this divider. In parallel the output of the prescaler connects to an 11-bit B-divider. The 11-bit PC register (PC5 to PC15) controls this divider

Dividing range:

$f_{VCO} = [33 \times A + (B + 1 - A) \times 32] \times f_{REF}$

$f_{VCO} = (32 \times B + A + 32) \times f_{REF}$

Important: For correct operation: $A \leq 32$; $B \geq A$

4.3.3 Three state phase comparator

The phase comparator generates a phase error signal according to phase difference between f_{SYN} and f_{REF}. This phase error signal drives the charge pump current generator.

4.3.4 Charge pump current generator

This system generators signed pulses of current. The phase error signal decides the duration and polarity of those pulses. The current absolute values are programmable by A register for high current and B register for low current.

4.3.5 Inlock detector

Switching the charge pump in low current mode can be done either via software or automatically by the inlock detector, by setting bit LDENA to "1".

After reaching a phase difference about lower than 40 ns the charge pump is forced in low current mode. A new PLL divider alternation by I^2C bus will switch the charge pump in the high current mode.

4.3.6 Low noise CMOS Op-amp

An internal voltage divider at pin VREF2 connects the positive input of the low noise op-amp. The charge pump output connects the negative input. This internal amplifier in cooperation with external components can provide an active filter. The negative input is switchable to three input pins, to increase the flexibility in application. This feature allows two separate active filters for different applications.

While the high current mode is activated LPHC output is switched on.

4.3.7 IF counter block

The aim of IF counter is to measure the intermediate frequency of the tuner for AM and FM mode. The input signal for FM and AM up conversion is the same 10.7 MHz IF level after limiter. AM 450 kHz signal is coming from narrow filtered IF2 before demodulation. A switch controlled by IF counter mode (IFCM) is chosing the input signal for IF counter.

The grade of integration is adjustable by eight different measuring cycle times. The tolerance of the accepted count value is adjustable, to reach an optimum compromise for search speed and precision of the evaluation.

4.3.8 The IF-counter mode

The IF counter works in 3 modes controlled by IFCM register.

4.3.9 Sampling timer

A sampling timer generates the gate signal for the main counter. The basically sampling time are in FM mode 6.25 kHz (t_{TIM}=160 µs) and in AM mode 1 kHz (t_{TIM}=1ms). This is followed by an asynchronous divider to generate several sampling times.

4.3.10 Intermediate frequency main counter

This counter is a 11 - 21-bit synchronous auto reload down counter. Five bits (CF) are programmable to have the possibility for an adjust to the centre frequency of the IF-filter. The counter length is automatic adjusted to the chosen sampling time and the counter mode (FM, AM-UPC, AM).

At the start the counter will be loaded with a defined value which is an equivalent to the divider value ($t_{Sample} \times f_{IF}$).

If a correct frequency is applied to the IF counter frequency input at the end of the sampling time the main counter is changing its state from 0h to 1FFFFFh.

This is detected by a control logic and an external search stop output is changing from LOW to HIGH. The frequency range inside which a successful count result is adjustable by the EW bits.

$t_{CNT} = (CF + 1696+1) / f_{IF}$ FM mode
$t_{CNT} = (CF + 10688+1) / f_{IF}$ AM up conversion mode
$t_{CNT} = (CF + 488+1) / f_{IF}$ AM mode

Counter result succeeded:
$t_{TIM} \geq t_{CNT} - t_{ERR}$
$t_{TIM} \leq t_{CNT} + t_{ERR}$

Counter result failed:
$t_{TIM} > t_{CNT} + t_{ERR}$
$t_{TIM} < t_{CNT} - t_{ERR}$

t_{TIM} = IF timer cycle time (sampling time)

t_{CNT} = IF counter cycle time

t_{ERR} = discrimination window (controlled by the EW registers)

The IF counter is only started by inlock information from the PLL part. It is enabled by software (IFENA).

4.3.11 Adjustment of the measurement sequence time

The precision of the measurements is adjustable by controlling the discrimination window. This is adjustable by programming the control registers EW.

The measurement time per cycle is adjustable by setting the registers IFS.

4.3.12 Adjust of the frequency value

The center frequency of the discrimination window is adjustable by the control registers CF.

4.4 I^2C bus interface

The TDA7512 supports the I^2C bus protocol. This protocol defines any device that sends data onto the bus as a transmitter, and the receiving device as the receiver. The device that controls the transfer is a master and device being controlled is the slave. The master will always initiate data transfer and provide the clock to transmit or receive operations.

4.4.1 Data transition

Data transition on the SDA line must only occur when the clock SCL is LOW. SDA transitions while SCL is HIGH will be interpreted as START or STOP condition.

4.4.2 Start condition

A start condition is defined by a HIGH to LOW transition of the SDA line while SCL is at a stable HIGH level. This "START" condition must precede any command and initiate a data transfer onto the bus. The device continuously monitors the SDA and SCL lines for a valid START and will not response to any command if this condition has not been met.

4.4.3 Stop condition

A STOP condition is defined by a LOW to HIGH transition of the SDA while the SCL line is at a stable HIGH level. This condition terminates the communication between the devices and forces the bus-interface of the device into the initial condition.

4.4.4 Acknowledge

Indicates a successful data transfer. The transmitter will release the bus after sending 8 bits of data. During the 9^{th} clock cycle the receiver will pull the SDA line to LOW level to indicate it receive the eight bits of data.

4.4.5 Data transfer

During data transfer the device samples the SDA line on the leading edge of the SCL clock. Therefore, for proper device operation the SDA line must be stable during the SCL LOW to HIGH transition.

4.4.6 Device addressing

To start the communication between two devices, the bus master must initiate a start instruction sequence, followed by an eight bit word corresponding to the address of the device it is addressing.

The most significant 6 bits of the slave address are the device type identifier.

The TDA7512 device type is fixed as "110001".

The next significant bit is used to address a particular device of the previous defined type connected to the bus.

The state of the hardwired PIN41 defines the state of this address bit. So up to two devices could be connected on the same bus. When PIN41 is connected to VCC2 the address bit “1” is selected. In this case the AM part doesn’t work. Otherwise the address bit “0” is selected (FM and AM is working). Therefor a double FM tuner concept is possible.

The last bit of the start instruction defines the type of operation to be performed:

- When set to "1", a read operation is selected
- When set to "0", a write operation is selected

The TDA7512 connected to the bus will compare their own hardwired address with the slave address being transmitted, after detecting a START condition. After this comparison, the TDA7512 will generate an "acknowledge" on the SDA line and will do either a read or a write operation according to the state of R/W bit.

4.4.7 Write operation

Following a START condition the master sends a slave address word with the R/W bit set to "0". The device will generate an "acknowledge" after this first transmission and will wait for a second word (the word address field). This 8-bit address field provides an access to any of the 32 internal addresses. Upon receipt of the word address the TDA7512 slave device will respond with an "acknowledge". At this time, all the following words transmitted to the TDA7512 will be considered as Data. The internal address will be automatically incremented. After each word receipt the TDA7512 will answer with an "acknowledge".

4.4.8 Read operation

If the master sends a slave address word with the R/W bit set to "1", the TDA7512 will transit one 8-bit data word. This data word includes the following informations:

bit0 (ISS filter, 1 = ON, 0 = OFF)

bit1 (ISS filter bandwidth, 1 = 80 kHz, 0 = 120 kHz)

bit2 (MPOUT,1 = multipath present, 0 = no multipath)

bit3 (1 = PLL is locked in, 0 = PLL is locked out).

bit4 (fieldstrength indicator, 1 = lower as softmute threshold, 0 = higher as softmute threshold)

bit5 (adjacent channel indicator, 1 = adjacent channel present, 0 = no adjacent channel)

bit6 (deviation indicator, 1 = strong overdeviation present, 0 = no strong overdeviation)

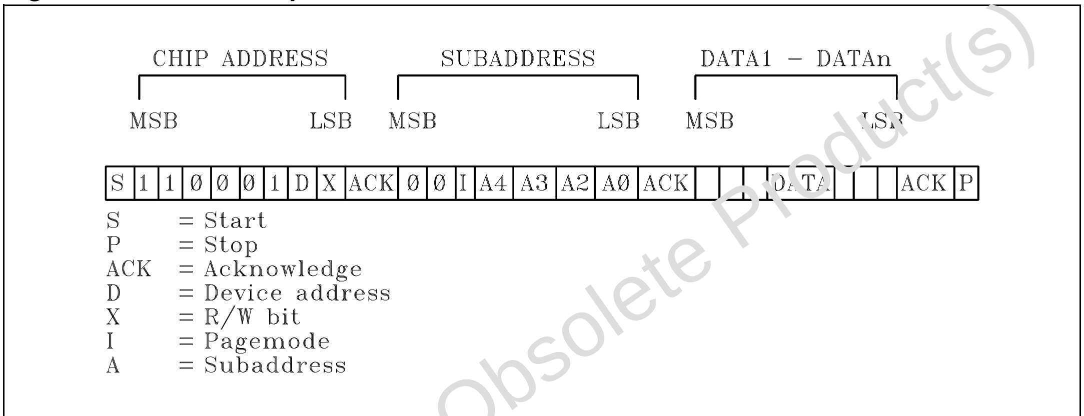
bit7 (deviation indicator, 1 = overdeviation present, 0 = no overdeviation)

5 Software specification

The interface protocol comprises:

- start condition (S)
- chip address byte
- subaddress byte
- sequence of data (N bytes + Acknowledge)
- stop condition (P)

Figure 3. Software specification



5.1 Address organization

Table 8. Address organization

Function	Addr	7	6	5	4	3	2	1	0
CHARGE PUMP	0	LDENA	CURRH	B1	B0	A3	A2	A1	A0
PLL COUNTER	1	PC7	PC6	PC5	PC4	PC3	PC2	PC1	PC0
	2	PC15	PC14	PC13	PC12	PC11	PC10	PC9	PC8
TV1	3	TV1O7	TV1O6	TV1O5	TV1O4	TV1O3	TV1O2	TV1O1	TV1O0
TV2	4	TV2O7	TV2O6	TV2O5	TV2O4	TV2O3	TV2O2	TV2O1	TV2O0
IFC CTRL 1	5	LM	CASF	IFCM1	IFCM0	IFENA	IFS2	IFS1	IFS0
IFC CTRL 2	6	EW2	EW1	EW0	CF4	CF3	CF2	CF1	CF0
AM CTL	7	-	-	-	-	AMD1	AMD0	AMST	AMSEEK
QUALITYISS	8	TISS2	TISS1	TISS0	TVWB	ISS30	ISS80	ISSON	CTLOFF
QUALITY AC	9	ACNTH1	ACNTH0	ACWTH2	ACWTH1	ACWTH0	ACG	ACF	-
QUALITY MP	10	MPAC	APPM2	APPM1	MPTH1	MPTH0	MPG	MPF	MPOFF
QUALITYDEV	11	BWCTL	DTH1	DTH0	DWTH1	DWTH0	TDEV2	TDEV1	TDEV0
MUTE1	12	MENA	SMD3	SMD2	SMD1	SMD0	SMTH2	SMTH1	SMTH0

Table 8. Address organization (continued)

Function	Addr	7	6	5	4	3	2	1	0
MUTE2	13	F100K	ACM3	ACM2	ACM1	ACM0	ACMD1	ACMD0	SMCTH
VCO/PLLREF	14	LPF	AMON	RC2	RC1	RC0	VCOD2	VCOD1	VCOD0
FMAGC	15	-	KAGC2	KAGC1	KAGC0	IFAGC1	IFAGC0	RFAGC1	RFAGC0
AMAGC	16	DAGC3	DAGC2	DAGC1	DAGC0	WAGC3	WAGC2	WAGC1	WAGC0
DEM ADJ	17	DNB1	DNB0	DEM5	DEM4	DEM3	DEM2	DEM1	DEM0
LEVEL	18	ODSW	AMIN	SMSL	SL4	SL3	SL2	SL1	SL0
IF1/XTAL	19	XTAL4	XTAL3	XTAL2	XTAL1	XTAL0	IFG11	IFG10	IFG2
TANK ADJ	20	IF1T3	IF1T2	IF1T1	IF1T0	IF2T3	IF2T2	IF2T1	IF2T0
I/Q ADJ	21	ODCUR	-	G1	G0	PH3	PH2	PH1	PH0
TESTCTRL1	22	-	ISSIN	TOUT	TIN	CLKSEP	TEST3	TEST2	TEST1
TESTCTRL2	23	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0
TESTCTRL3	24	-	TINACM	TINMP	TINAC	OUT11	OUT10	OUT9	OUT8
TESTCTRL4	25	-	-	-	OUT16	OUT15	OUT14	OUT13	OUT12

5.2 Control register function

Table 9. Control register function

Register name	Function
A	Charge pump high current
ACF	Adjacent channel filter select
ACG	Adjacent channel filter gain
ACM	Threshold for startpoint adjacent channel mute
ACMD	Adjacent channel mute depth
ACNTH	Adjacent channel narrow band threshold
ACWTH	Adjacent channel wide band threshold
AMD	AM prescaler
AMIN	AM IF1 input select
AMON	AM-FM switch
AMSEEK	Set short time constant of AGC in AM seek mode
AMST	AM stereo select
APPM	Application mode quality detection
B	Charge pump low current
BWCTL	ISS filter fixed bandwidth (ISS80) in automatic control
CASF	Check alternative station frequency
CF	Center frequency IF counter

Table 9. Control register function (continued)

Register name	Function
CLKSEP	Clock separation (only for testing)
CTLOFF	Switch off automatic control of ISS filter
CURRH	Set current high charge pump
DAGC	AM narrow band AGC threshold
DEM	Demodulator offset
DNB	Demodulator noise spike blanking
DTH	Deviation detector threshold for ISS filter “OFF”
DWTH	Deviation detector threshold for ISS filter narrow/wide
EW	Frequency error window IF counter
F100K	Corner frequency of AC-mute high pass filter
G	I/Q mixer gain adjust
IF1T	FM/AM mixer1 tank adjust
IF2T	AM mixer2 tank adjust
IFAGC	FM IF AGC
IFCM	IF counter mode
IFENA	IF counter enable
IFG	IF1 amplifier gain (10.7 MHz)
IFS	IF counter sampling time
ISSIN	Test input for ISS filter
ISSON	ISS filter “ON”
ISS30	ISS filter 30 kHz weather band
ISS80	ISS filter narrow/mid switch
KAGC	FM keying AGC
LDENA	Lock detector enable
LM	Local mode FM seek stop
LPF	Loop filter input select
MENA	Softmute enable
MPAC	Adjacent channel control by multipath
MPF	Multipath filter frequency
MPG	Multipath filter gain
MPOFF	Multipath control “OFF”
MPTH	Multipath threshold
ODCUR	Current for overdeviation-correction
ODSW	Overdeviation-correction enable
OUT	Test output (only for testing)

Table 9. Control register function (continued)

Register name	Function
PC	Counter for PLL (VCO frequency)
PH	I/Q mixer phase adjust
RC	Reference counter PLL
RFAGC	FM RF AGC
SL	S meter slider
SMCTH	Softmute capacitor threshold for ISS “ON”
SMD	Softmute depth threshold
SMSL	S meter slope
SMTH	Softmute startpoint threshold
TDEV	Time constant for deviation detector
TEST	Testing PLL/IFC (only for testing)
TIN	Switch FSU PIN to TEST input (only for testing)
TINAC	Test input adjacent channel (only for testing)
TINACM	Test input adjacent channel mute (only for testing)
TINMP	Test input multipath (only for testing)
TISS	Time constant for ISS filter “ON”/”OFF”
TOUT	Switch FSU PIN to Test output (only for testing)
TVO	Tuning voltage offset for prestage
TVWB	Tuning voltage offset for prestage (weather band mode)
VCOD	VCO divider
WAGC	AM wide band AGC
XTAL	Crystal frequency adjust

Table 10. Subaddress

MSB							LSB	Function
0	0	I	A4	A3	A2	A1	A0	
-	-	-	0	0	0	0	0	Charge pump control
-	-	-	0	0	0	0	1	PLL lock detector
-	-	-	-	-	-	-	-	-
-	-	-	1	0	1	0	1	I/Q ADJ
-	-	0	-	-	-	-	-	Page mode “OFF”
-	-	1	-	-	-	-	-	Page mode enable

5.3 Data byte specification

Table 11. Addr 0 charge pump control

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	0	0	0	0	High current = 0 mA
-	-	-	-	0	0	0	1	High current = 0.5 mA
-	-	-	-	0	0	1	0	High current = 1 mA
-	-	-	-	0	0	1	1	High current = 1.5 mA
-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	1	High current = 7.5 mA
-	-	0	0	-	-	-	-	Low current = 0 µA
-	-	0	1	-	-	-	-	Low current = 50 µA
-	-	1	0	-	-	-	-	Low current = 100 µA
-	-	1	1	-	-	-	-	Low current = 150 µA
-	0	-	-	-	-	-	-	Select low current
-	1	-	-	-	-	-	-	Select high current
0	-	-	-	-	-	-	-	Lock detector disable
1	-	-	-	-	-	-	-	Lock detector enable

Table 12. Addr 1 PLL counter 1 (LSB)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	LSB = 0
0	0	0	0	0	0	0	1	LSB = 1
0	0	0	0	0	0	1	0	LSB = 2
-	-	-	-	-	-	-	-	-
1	1	1	1	1	1	0	0	LSB = 252
1	1	1	1	1	1	0	1	LSB = 253
1	1	1	1	1	1	1	0	LSB = 254
1	1	1	1	1	1	1	1	LSB = 255

Table 13. Addr 2 PLL counter 2 (MSB)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	MSB = 0
0	0	0	0	0	0	0	1	MSB = 256
0	0	0	0	0	0	1	0	MSB = 512
-	-	-	-	-	-	-	-	-
1	1	1	1	1	1	0	0	MSB = 64768
1	1	1	1	1	1	0	1	MSB = 65024
1	1	1	1	1	1	1	0	MSB = 65280
1	1	1	1	1	1	1	1	MSB = 65536

Note: Swallow mode: $f_{VCO}/f_{SYN} = LSB + MSB + 32$

Table 14. Addr 3,4 TV1,2 (offset referred to tuning voltage PIN28)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	0	0	0	0	0	0	0	Tuning voltage Offset = 0
-	0	0	0	0	0	0	1	TVO = 25 mV
-	0	0	0	0	0	1	0	TVO = 50 mV
-	-	-	-	-	-	-	-	-
-	1	1	1	1	1	1	1	TVO = 3175 mV
0	-	-	-	-	-	-	-	-TVO
1	-	-	-	-	-	-	-	+TVO

Table 15. Addr 5 IF counter control 1

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	0	0	0	t_{Sample} = 20.48 ms (FM)128 ms (AM)
-	-	-	-	-	0	0	1	t_{Sample} = 10.24 ms (FM)64 ms (AM)
-	-	-	-	-	0	1	0	t_{Sample} = 5.12 ms (FM)32 ms (AM)
-	-	-	-	-	0	1	1	t_{Sample} = 2.56 ms (FM)16 ms (AM)
-	-	-	-	-	1	0	0	t_{Sample} = 1.28 ms (FM)8 ms (AM)
-	-	-	-	-	1	0	1	t_{Sample} = 640 µs (FM)4 ms (AM)
-	-	-	-	-	1	1	0	t_{Sample} = 320 µs (FM)2 ms (AM)
-	-	-	-	-	1	1	1	t_{Sample} = 160 µs (FM)1 ms (AM)
-	-	-	-	0	-	-	-	IF counter disable / stand by
-	-	-	-	1	-	-	-	IF counter enable
-	-	0	0	-	-	-	-	Not valid
-	-	0	1	-	-	-	-	IF counter FM mode
-	-	1	0	-	-	-	-	IF counter AM mode (450 kHz)
-	-	1	1	-	-	-	-	IF counter AM mode (10.7 MHz)
-	0	-	-	-	-	-	-	Disable mute & AGC on hold in FM mode
-	1	-	-	-	-	-	-	Enable mute & AGC on hold in FM mode
0	-	-	-	-	-	-	-	Disable local mode
1	-	-	-	-	-	-	-	Enable local mode (PIN diode current = 0.5 mA) “ON”

Table 16. Addr 6 IF counter control 2

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	0	0	0	0	0	f_{Center} = 10.60625 MHz (FM) / 10.689 MHz; 449 kHz (AM)
-	-	-	0	0	0	0	1	f_{Center} = 10.61250 MHz (FM) / 10.690 MHz; 450 kHz (AM)
-	-	-	-	-	-	-	-	-
-	-	-	0	1	0	1	1	f_{Center} = 10.67500 MHz (FM) / 10.700 MHz; 460 kHz (AM)
-	-	-	0	1	1	0	0	f_{Center} = 10.68125 MHz (FM) / 10.701 MHz; 461 kHz (AM)
-	-	-	0	1	1	0	1	f_{Center} = 10.68750 MHz (FM) / 10.702 MHz; 462 kHz (AM)
-	-	-	0	1	1	1	0	f_{Center} = 10.69375 MHz (FM) / 10.703 MHz; 463 kHz (AM)
-	-	-	0	1	1	1	1	f_{Center} = 10.70000 MHz (FM) / 10.704 MHz; 464 kHz(AM)
-	-	-	-	-	-	-	-	-
-	-	-	1	1	1	1	1	f_{Center} = 10.80000 MHz (FM) / 10.720 MHz;480 kHz (AM)
0	0	0	-	-	-	-	-	Not valid
0	0	1	-	-	-	-	-	Not valid

Table 16. Addr 6 IF counter control 2 (continued)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	-	-	-	-	-	Not valid
0	1	1	-	-	-	-	-	Δf = 6.25 kHz (FM) 1 kHz (AM)
1	0	0	-	-	-	-	-	Δf = 12.5 kHz (FM) 2 kHz (AM)
1	0	1	-	-	-	-	-	Δf = 25 kHz (FM) 4 kHz (AM)
1	1	0	-	-	-	-	-	Δf = 50 kHz (FM) 8 kHz (AM)
1	1	1	-	-	-	-	-	Δf = 100 kHz (FM) 16 kHz (AM)

Table 17. Addr 7 AM control

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0	Normal AGC time constant
-	-	-	-	-	-	-	1	Short time constant for AM seek stop
-	-	-	-	-	-	0	-	Multipath information available FM at PIN34
-	-	-	-	-	-	1	-	AM stereo output available at PIN34
-	-	-	-	0	0	-	-	Prescaler ratio 10
-	-	-	-	0	1	-	-	Prescaler ratio 8
-	-	-	-	1	0	-	-	Prescaler ratio 6
-	-	-	-	1	1	-	-	Prescaler ratio 4

Table 18. Addr 8 quality ISS filter

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0	ISS filter control "ON"
-	-	-	-	-	-	-	1	ISS filter control "OFF"
-	-	-	-	-		0	-	Switch ISS filter "OFF"
-	-	-	-	-		1	-	Switch ISS filter "ON"
-	-	-	-	-	0	-	-	Switch "OFF" ISS filter 120 kHz
-	-	-	-	-	1	-	-	Switch "ON" ISS filter 80 kHz
-	-	-	-	0	-	-	-	Switch "OFF" ISS filter 30 kHz for weatherband
-	-	-	-	1	-	-	-	Switch "ON" ISS filter 30 kHz for weatherband
-	-	-	0	-	-	-	-	Disable TV offset for weather band
-	-	-	1	-	-	-	-	Enable TV offset for weather band (+4V)
0	0	0		-	-	-	-	discharge current 1µA, charge current mid 74µA narrow124µA
0	0	1		-	-	-	-	discharge current 3µA, charge current mid 72µA narrow122µA

Table 18. Addr 8 quality ISS filter (continued)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	-	-	-	-	-	discharge current 5 µA, charge current mid 70 µA narrow120 µA
0	1	1	-	-	-	-	-	discharge current 7 µA, charge current mid 68 µA narrow118 µA
-	-	-	-	-	-	-	-	-
1	1	1	-	-	-	-	-	discharge current 15 µA, charge current mid 60 µA narrow 110 µA

Table 19. Addr 9 quality detection adjacent channel

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0/1	Not valid
-	-	-	-	-	-	0	-	AC highpass frequency 100 kHz
-	-	-	-	-	-	1	-	AC bandpass frequency 200 kHz
-	-	-	-	-	0	-	-	AC gain 32 dB
-	-	-	-	-	1	-	-	AC gain 38 dB
-	-	0	0	0	-	-	-	AC wide band threshold 0.25 V
-	-	0	0	1	-	-	-	AC wide band threshold 0.35 V
-	-	0	1	0	-	-	-	AC wide band threshold 0.45 V
-	-	-	-	-	-	-	-	-
-	-	1	1	1	-	-	-	AC wide band threshold 0.95 V
0	0	-	-	-	-	-	-	AC narrow band threshold 0.0 V
0	1	-	-	-	-	-	-	AC narrow band threshold 0.1 V
1	0	-	-	-	-	-	-	AC narrow band threshold 0.2 V
1	1	-	-	-	-	-	-	AC narrow band threshold 0.3 V

Table 20. Addr 10 quality detection multipath

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0	Multipath control “ON”
-	-	-	-	-	-	-	1	Multipath control “OFF”
-	-	-	-	-	-	0	-	MP bandpass frequency 19 kHz
-	-	-	-	-	-	1	-	MP bandpass frequency 31 kHz
-	-	-	-	-	0	-	-	MP gain 12 dB
-	-	-	-	-	1	-	-	MP gain 23 dB
-	-	-	0	0	-	-	-	MP threshold 0.50 V

Table 20. Addr 10 quality detection multipath (continued)

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	0	1	-	-	-	MP threshold 0.75 V
-	-	-	1	0	-	-	-	MP threshold 1.00 V
-	-	-	1	1	-	-	-	MP threshold 1.25 V
-	0	0	-	-	-	-	-	Application mode 1
-	0	1	-	-	-	-	-	Application mode 2
0	-	-	-	-	-	-	-	Multipath eliminates ac
1	-	-	-	-	-	-	-	Multipath eliminates ac and ac+

Table 21. Addr 11 quality deviation detection

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	0	0	0	charge current 34 µA, discharge current 6µA
-	-	-	-	-	0	0	1	charge current 32 µA, discharge current 8 µA
-	-	-	-	-	0	1	0	charge current 30 µA, discharge current 10 µA
-	-	-	-	-	0	1	1	charge current 28 µA, discharge current 12 µA
-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	1	1	charge current 20 µA, discharge current 20 µA
-	-	-	0	0	-	-	-	DEV threshold for ISS narrow/wide 30 kHz
-	-	-	0	1	-	-	-	DEV threshold for ISS narrow/wide 45 kHz
-	-	-	1	0	-	-	-	DEV threshold for ISS narrow/wide 60 kHz
-	-	-	1	1	-	-	-	DEV threshold for ISS narrow/wide 75 kHz
-	0	0	-	-	-	-	-	DEV threshold for ISS filter “OFF” ratio 1.5
-	0	1	-	-	-	-	-	DEV threshold for ISS filter “OFF” ratio 1.4
-	1	0	-	-	-	-	-	DEV threshold for ISS filter “OFF” ratio 1.3
-	1	1	-	-	-	-	-	DEV threshold for ISS filter “OFF” ratio 1
0	-	-	-	-	-	-	-	Disable ISS filter to fixed bandwidth (ISS80) in automatic control
1	-	-	-	-	-	-	-	Enable ISS filter to fixed bandwidth (ISS80) in automatic control

Table 22. Addr 12 softmute control 1

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	0	0	0	Startpoint mute 0 in application about 3 dBμV antenna level
-	-	-	-	-	0	0	1	Startpoint mute 1in application about 4 dBμV antenna level
-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	1	1	Startpoint mute 7in application about 10 dBμV antenna level
-	0	0	0	0	-	-	-	Mute depth 0 in application 18 dB
-	0	0	0	1	-	-	-	Mute depth 1 in application 20 dB
-	0	0	1	0	-	-	-	Mute depth 2 in application 22 dB
-	0	0	1	1	-	-	-	Mute depth 3 in application 24 dB
-	-	-	-	-	-	-	-	- (logarithmically behavior)
-	1	1	1	1	-	-	-	Mute depth 15 in application 36 dB
0	-	-	-	-	-	-	-	Mute disable
1	-	-	-	-	-	-	-	Mute enable

Table 23. Addr 13 softmute control 2

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0	Disable mute threshold for ISS filter “ON”
-	-	-	-	-	-	-	1	Enable mute threshold for ISS filter “ON”
-	-	-	-	-	0	0	-	AC mute depth 10 dB
-	-	-	-	-	0	1	-	AC mute depth 8 dB
-	-	-	-	-	1	0	-	AC mute depth 6 dB
-	-	-	-	-	1	1	-	AC mute depth 4 dB
-	0	0	0	0	-	-	-	AC mute threshold 60 mV
-	0	0	0	1	-	-	-	AC mute threshold 80 mV
-	0	0	1	0	-	-	-	AC mute threshold 100 mV
-	-	-	-	-	-	-	-	-
-	0	1	1	1	-	-	-	AC mute threshold 340 mV
-	1	1	1	1	-	-	-	AC mute “OFF”
0	-	-	-	-	-	-	-	AC mute filter 110 kHz
1	-	-	-	-	-	-	-	AC mute filter 100 kHz

Table 24. Addr 14 VCODIV/PLLREF

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	0	0	not valid (only for testing)
-	-	-	-	-	-	0	1	VCO frequency divided by 2
-	-	-	-	-	-	1	0	VCO frequency divided by 3
-	-	-	-	-	-	1	1	original VCO frequency
-	-	-	-	-	0	-	-	VCO” I” signal 0 degree
-	-	-	-	-	1	-	-	VCO “I” signal 180 degree
-	-	1	0	0	-	-	-	PLL reference frequency 50 kHz
-	-	1	0	1	-	-	-	PLL reference frequency 25 kHz
-	-	1	1	0	-	-	-	PLL reference frequency 10 kHz
-	-	1	1	1	-	-	-	PLL reference frequency 9 kHz
-	-	0	0	0	-	-	-	PLL reference frequency 2 kHz
-	0	-	-	-	-	-	-	Select FM mode
-	1	-	-	-	-	-	-	Select AM mode
0		-	-	-	-	-	-	Select PLL low pass filter FM
1		-	-	-	-	-	-	Select PLL low pass filter AM

Table 25. Addr 15 FM AGC

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	0	0	RFAGC threshold $V_{7\text{-}9TH}$= 85 (77 ANT) dBμV
-	-	-	-	-	-	0	1	RFAGC threshold $V_{7\text{-}9TH}$= 90 (82 ANT) dBμV
-	-	-	-	-	-	1	0	RFAGC threshold $V_{7\text{-}9TH}$= 94 (86 ANT) dBμV
-	-	-	-	-	-	1	1	RFAGC threshold $V_{7\text{-}9TH}$= 96 (88 ANT) dBμV
-	-	-	-	0	0	-	-	IFAGC threshold V_{60TH}= 86 (60 ANT) dBμV
-	-	-	-	0	1	-	-	IFAGC threshold V_{60TH}= 92 (66 ANT) dBμV
-	-	-	-	1	0	-	-	IFAGC threshold V_{60TH}= 96 (70 ANT) dBμV
-	-	-	-	1	1	-	-	IFAGC threshold V_{60TH}= 98 (72 ANT) dBμV
-	0	0	0	-	-	-	-	KAGC threshold 80 dBμV
-	0	0	1	-	-	-	-	KAGC threshold 82 dBμV
-	0	1	0	-	-	-	-	KAGC threshold 84 dBμV
-	0	1	1	-	-	-	-	KAGC threshold 86 dBμV
-	1	0	0	-	-	-	-	KAGC threshold 88 dBμV
-	1	0	1	-	-	-	-	KAGC threshold 90 dBμV
-	1	1	0	-	-	-	-	KAGC threshold 92 dBμV
-	1	1	1	-	-	-	-	Keying AGC “OFF”
0	-	-	-	-	-	-	-	has to be “0”

Table 26. Addr 16 AM AGC

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	0	0	0	0	WAGC V_{3TH}= 90(65 ANT) dBµ V_{58TH}= 90(60 ANT) dBµ
-	-	-	-	0	0	0	1	WAGC V_{3TH}= 94(69 ANT) dBµ V_{58TH}= 94(64 ANT) dBµ
-	-	-	-	0	0	1	0	WAGC V_{3TH}= 97(72 ANT) dBµ V_{58TH}= 96.5(66.5 ANT) dBµ
-	-	-	-	0	0	1	1	WAGC V_{3TH}= 98.5(73.5 ANT) dBµ V_{58TH}= 98.5(68.5 ANT) dBµ
-	-	-	-	0	1	0	0	WAGC V_{3TH}= 100(75 ANT) dBµ V_{58TH}= 100(70 ANT) dBµ
-	-	-	-	0	1	0	1	WAGC V_{3TH}= 101.5(76.5 ANT) dBµ V_{58TH}= 101(71 ANT) dBµ
-	-	-	-	0	1	1	0	WAGC V_{3TH}= 102.5(77.5 ANT) dBµV_{58TH}= 102.5(72.5 ANT) dBµ
-	-	-	-	0	1	1	1	WAGC V_{3TH}= 103.5(78.5 ANT) dBµV_{58TH}= 103.5(73.5 ANT) dBµ
-	-	-	-	1	0	0	0	WAGC V_{3TH}= 104.5(79.5 ANT) dBµ V_{58TH}= 104(74 ANT) dBµ
-	-	-	-	1	0	0	1	WAGC V_{3TH}= 105(80 ANT) dBµ V_{58TH}= 105(75 ANT) dBµ
-	-	-	-	1	0	1	0	WAGC V_{3TH}= 106(81 ANT) dBµ V_{58TH}= 105.5(75.5 ANT) dBµ
-	-	-	-	1	0	1	1	WAGC V_{3TH}= 106.5(81.5 ANT) dBµV_{58TH}= 106.5(76.5 ANT) dBµ
-	-	-	-	1	1	0	0	WAGC V_{3TH}= 107(82 ANT) dBµ V_{58TH}= 107(77 ANT) dBµ
-	-	-	-	1	1	0	1	WAGC V_{3TH}= 108(83 ANT) dBµ V_{58TH}= 107.5(77.5 ANT) dBµ
-	-	-	-	1	1	1	0	WAGC V_{3TH}= 108.5(83.5 ANT) dBµ V_{58TH}= 108(78 ANT) dBµ
-	-	-	-	1	1	1	1	WAGC V_{3TH}= 109(84 ANT) dBµ V_{58TH}= 108.5(78.5 ANT) dBµ
0	0	0	0	-	-	-	-	DAGC V_{58TH}= 74(44 ANTTENNA) dBµ
0	0	0	1	-	-	-	-	DAGC V_{58TH}= 77(47 ANTTENNA) dBµ
0	0	1	0	-	-	-	-	DAGC V_{58TH}= 79(49 ANTTENNA) dBµ
0	0	1	1	-	-	-	-	DAGC V_{58TH}= 80.5(50.5 ANTTENNA) dBµ
0	1	0	0	-	-	-	-	DAGC V_{58TH}= 82(52 ANTTENNA) dBµ
0	1	0	1	-	-	-	-	DAGC V_{58TH}= 83.5(53.5 ANTTENNA) dBµ
0	1	1	0	-	-	-	-	DAGC V_{58TH}= 85(55 ANTTENNA) dBµ
0	1	1	1	-	-	-	-	DAGC V_{58TH}= 86.5(56.5 ANTTENNA) dBµ
1	0	0	0	-	-	-	-	DAGC V_{58TH}= 88(58 ANTTENNA) dBµ
1	0	0	1	-	-	-	-	DAGC V_{58TH}= 89(59 ANTTENNA) dBµ
1	0	1	0	-	-	-	-	DAGC V_{58TH}= 90(60 ANTTENNA) dBµ
1	0	1	1	-	-	-	-	DAGC V_{58TH}= 91(61 ANTTENNA) dBµ
1	1	0	0	-	-	-	-	DAGC V_{58TH}= 92(62 ANTTENNA) dBµ
1	1	0	1	-	-	-	-	DAGC V_{58TH}= 93(63 ANTTENNA) dBµ
1	1	1	0	-	-	-	-	DAGC V_{58TH}= 94(64 ANTENNA) dBµ
1	1	1	1	-	-	-	-	DAGC V_{58TH}= 96(66 ANTENNA) dBµ

Table 27. Addr 17 FM demodulator fine adjust

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	0	0	0	0	0	0	0 mV
-	-	0	0	0	0	0	1	+8.5 mV
-	-	0	0	0	0	1	0	+17 mV
-	-	-	-	-	-	-	-	-
-	-	0	1	1	1	1	1	+263.5 mV
-	-	1	0	0	0	0	0	0 mV
-	-	1	0	0	0	0	1	-8.5 mV
-	-	1	0	0	0	1	0	-17 mV
-	-	-	-	-	-	-	-	-
-	-	1	1	1	1	1	1	-263.5 mV
0	0	-	-	-	-	-	-	Spike cancellation ”OFF”
0	1	-	-	-	-	-	-	Threshold for spike cancellation 270 mV
1	0	-	-	-	-	-	-	Threshold for spike cancellation 520 mV
1	1	-	-	-	-	-	-	Threshold for spike cancellation 750 mV

Table 28. Addr 18 S-meter slider

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	0	0	0	0	S meter slider offset SL = 0 dB
-	-	-	-	0	0	0	1	S meter offset SL = 1 dB
-	-	-	-	0	0	1	0	S meter offset SL = 2 dB
-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	1	S meter offset SL=15 dB
-	-	-	0	-	-	-	-	S meter offset -SL
-	-	-	1	-	-	-	-	S meter offset +SL
-	-	0		-	-	-	-	S Meter slope 1V/decade
-	-	1	-	-	-	-	-	S meter slope 1.5V/decade
-	0	-	-	-	-	-	-	Select external AM-IF input
-	1	-	-	-	-	-	-	Select internal AM-IF input
0	-	-	-	-	-	-	-	Overdeviation correction “ON”
1	-	-	-	-	-	-	-	Overdeviation correction “OFF”

Table 29. Addr 19 IF GAIN/Crystal adjust

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	-	-	-	0	IF1 gain2 9 dB
-	-	-	-	-	-	-	1	IF1 gain2 11 dB
-	-	-	-	-	0	0	-	IF1 gain1 9 dB
-	-	-	-	-	0	1	-	IF1 gain1 11 dB
-	-	-	-	-	1	0	-	IF1 gain1 12 dB
-	-	-	-	-	1	1	-	IF1 gain1 15 dB
0	0	0	0	0	-	-	-	C_{Load} 0 pF
0	0	0	0	1	-	-	-	C_{Load} 0.75 pF
0	0	0	1	0	-	-	-	C_{Load} 1.5 pF
0	0	0	1	1	-	-	-	C_{Load} 2.25 pF
0	0	1	0	0	-	-	-	C_{Load} 3 pF
-	-	-	-	-	-	-	-	-
1	1	1	1	1	-	-	-	C_{Load} 23.25 pF

Table 30. Addr 20 tank adjust

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	0	0	0	0	450 kHz 0 pF
-	-	-	-	0	0	0	1	450 kHz 1.6 pF
-	-	-	-	0	0	1	0	450 kHz 3.2 pF
-	-	-	-	0	0	1	1	450 kHz 4.8 pF
-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	1	450 kHz 24 pF
0	0	0	0	-	-	-	-	10.7 MHz 0 pF
0	0	0	1	-	-	-	-	10.7 MHz 0.55 pF
0	0	1	0	-	-	-	-	10.7 MHz 1.1 pF
0	0	1	1	-	-	-	-	10.7 MHz 1.65 pF
-	-	-	-	-	-	-	-	-
1	1	1	1	-	-	-	-	10.7 MHz 8.25 pF

Table 31. Addr 21 I/Q FM mixer1 adjust

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
-	-	-	-	0	0	0	0	-7 degree
-	-	-	-	0	0	0	1	-6 degree
-	-	-	-	0	0	1	0	-5 degree
-	-	-	-	-	-	-	-	-
-	-	-	-	0	1	1	1	0 degree
-	-	-	-	1	0	0	0	+1 degree
-	-	-	-	1	0	0	1	+2 degree
-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	1	+8degree
-	-	0	0	-	-	-	-	0%
-	-	0	1	-	-	-	-	-1%
-	-	1	0	-	-	-	-	+1%
-	-	1	1	-	-	-	-	0%
-	x	-	-	-	-	-	-	not used
0	-	-	-	-	-	-	-	Overdeviation correction current max=45 µA
1	-	-	-	-	-	-	-	Overdeviation correction current max=90 µA

Table 32. Addr 22 test control 1

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
x	x	x	x	x	x	x	x	Only for testing (have to be set to 0)

Table 33. Addr 23 test control 2

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
x	x	x	x	x	x	x	x	Only for testing (have to be set to 0)

Table 34. Addr 24 Test Control 3

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
x	x	x	x	x	x	x	x	Only for testing (have to be set to 0)

Table 35. Addr 25 test control 4

MSB							LSB	Function
D7	D6	D5	D4	D3	D2	D1	D0	
x	x	x	x	x	x	x	x	Only for testing (have to be set to 0)

6 Package information

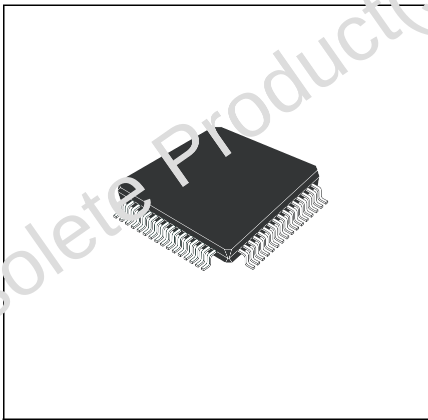
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

ECOPACK® is an ST trademark.

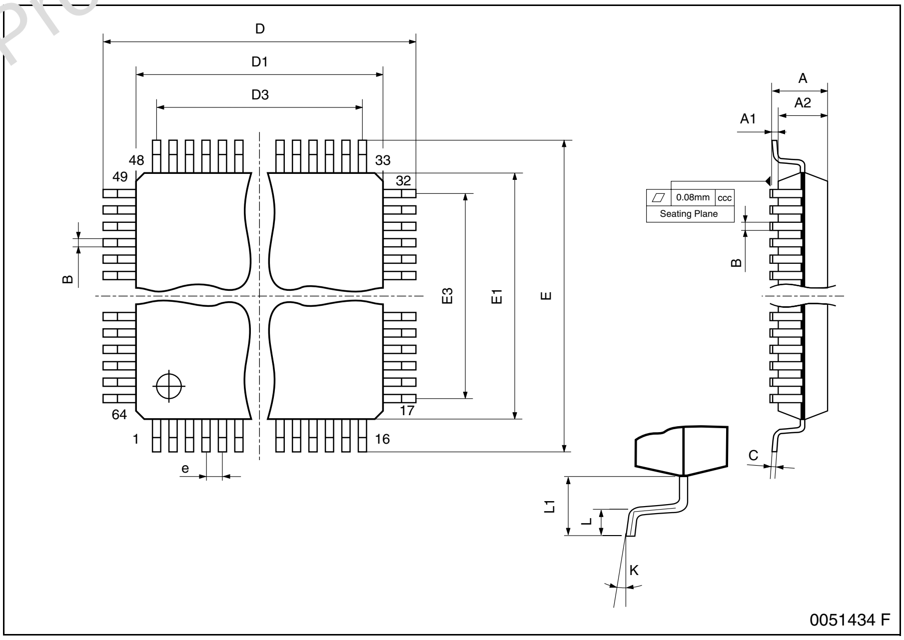
Figure 4. LQFP64 mechanical data and package dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.60			0.063
A1	0.05		0.15	0.002		0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
B	0.17	0.22	0.27	0.0066	0.0086	0.0106
C	0.09			0.0035		
D	11.80	12.00	12.20	0.464	0.472	0.480
D1	9.80	10.00	10.20	0.386	0.394	0.401
D3		7.50			0.295	
e		0.50			0.0197	
E	11.80	12.00	12.20	0.464	0.472	0.480
E1	9.80	10.00	10.20	0.386	0.394	0.401
E3		7.50			0.295	
L	0.45	0.60	0.75	0.0177	0.0236	0.0295
L1		1.00			0.0393	
K	0° (min.), 3.5° (typ.), 7° (max.)					
ccc			0.080			0.0031

OUTLINE AND MECHANICAL DATA



LQFP64 (10 x 10 x 1.4mm)



Appendix A Block diagrams

Figure 5. Block diagram I/Q mixer

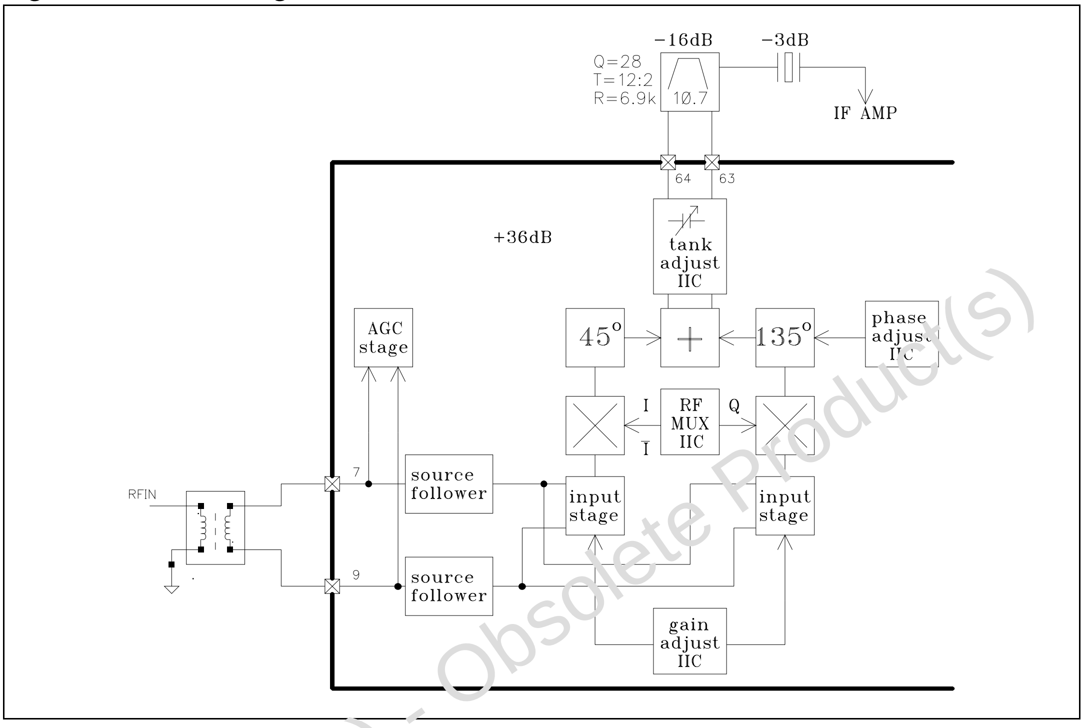


Figure 6. Block diagram VCO

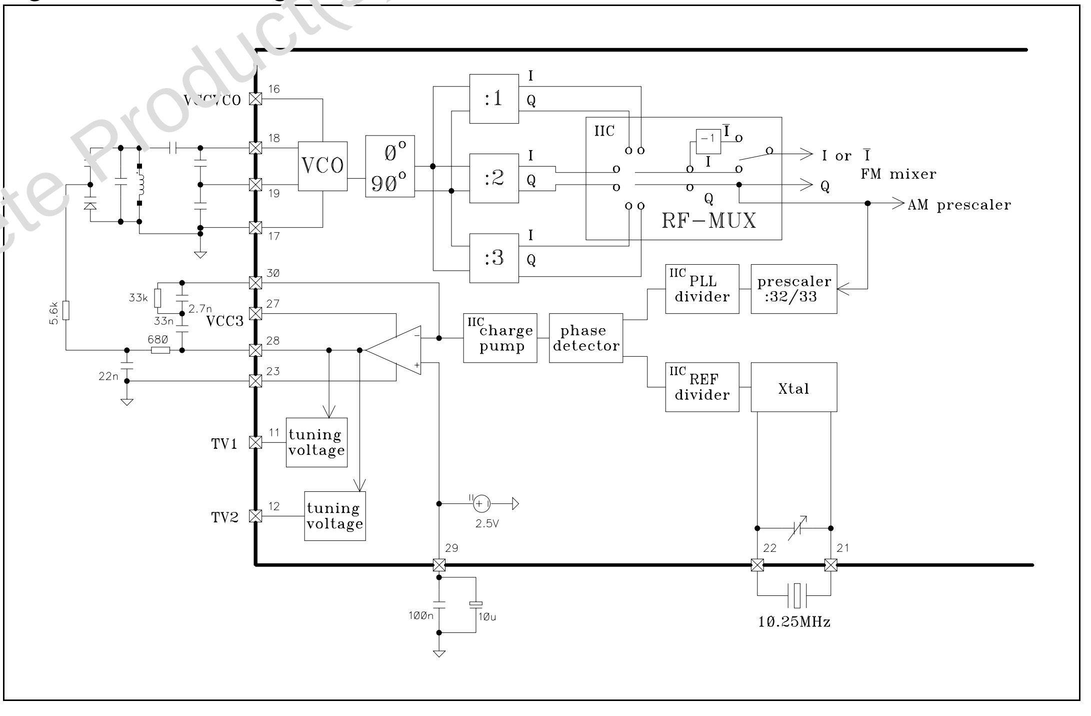


Figure 7. Block diagram keying AGC

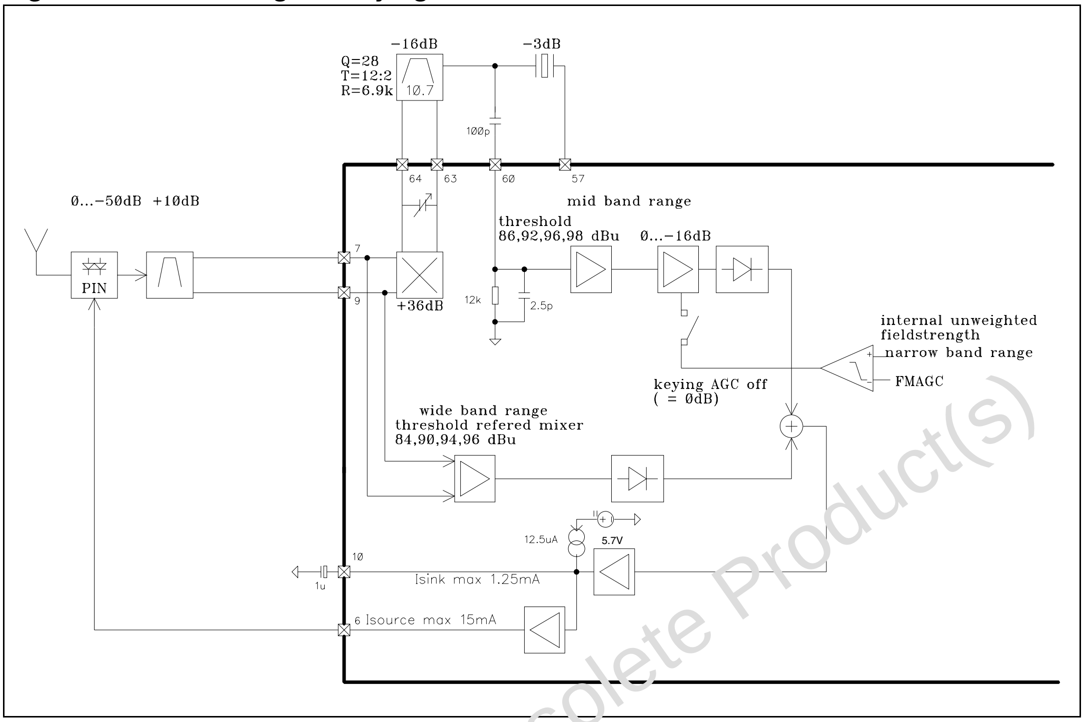


Figure 8. Block diagram ISS function

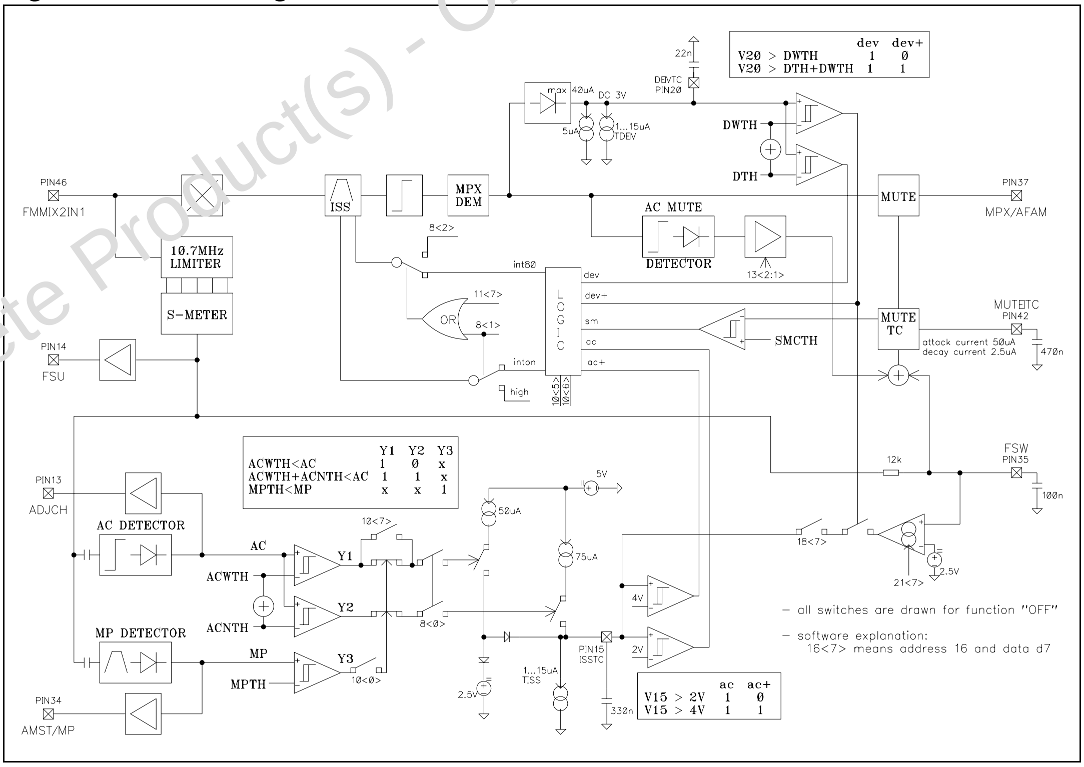


Table 36. Block diagram quality detection principle (without overdeviation correction)

Signal	LOW	HIGH
ac	No adjacent channel	Adjacent channel present
ac+	No strong adjacent channel	Adjacent channel higher as ac
sm	Fieldstrength higher as softmute threshold	Fieldstrength lower as softmute threshold
dev	Deviation lower as threshold DWTH	Deviation higher as threshold DWTH
dev+	Deviation lower as threshold DTH*DWTH	Deviation higher as threshold DTH*DWTH
inton	ISS filter off by logic (wide)	ISS filter on by logic
int80	ISS filter 120 kHz (mid)	ISS filter 80 kHz (narrow)

Table 37. Input signals modes

Input Signals					Mode1			Mode2		
ac	ac+	sm	dev	dev+	inton	int80	Function	inton	int80	Function
0	0	0	0	0	0	0	wide	0	0	wide
0	0	0	1	0	0	0	wide	0	0	wide
0	0	0	1	1	0	0	wide	0	0	wide
0	0	1	0	0	1	1	narrow	1	1	narrow
0	0	1	1	0	0	0	wide	1	0	mid
0	0	1	1	1	0	0	wide	0	0	wide
1	0	0	0	0	1	1	narrow	1	0	mid
1	1	0	0	0	1	1	narrow	1	1	narrow
1	0	0	1	0	1	0	mid	1	0	mid
1	1	0	1	1	1	0	mid	1	1	narrow
1	0	1	0	0	1	1	narrow	1	1	narrow
1	1	1	0	0	1	1	narrow	1	1	narrow
1	0	1	1	0	1	0	mid	1	0	mid
1	1	1	1	0	1	0	mid	1	1	narrow
1	0	1	1	1	1	0	mid	1	0	mid
1	1	1	1	1	1	0	mid	1	1	narrow

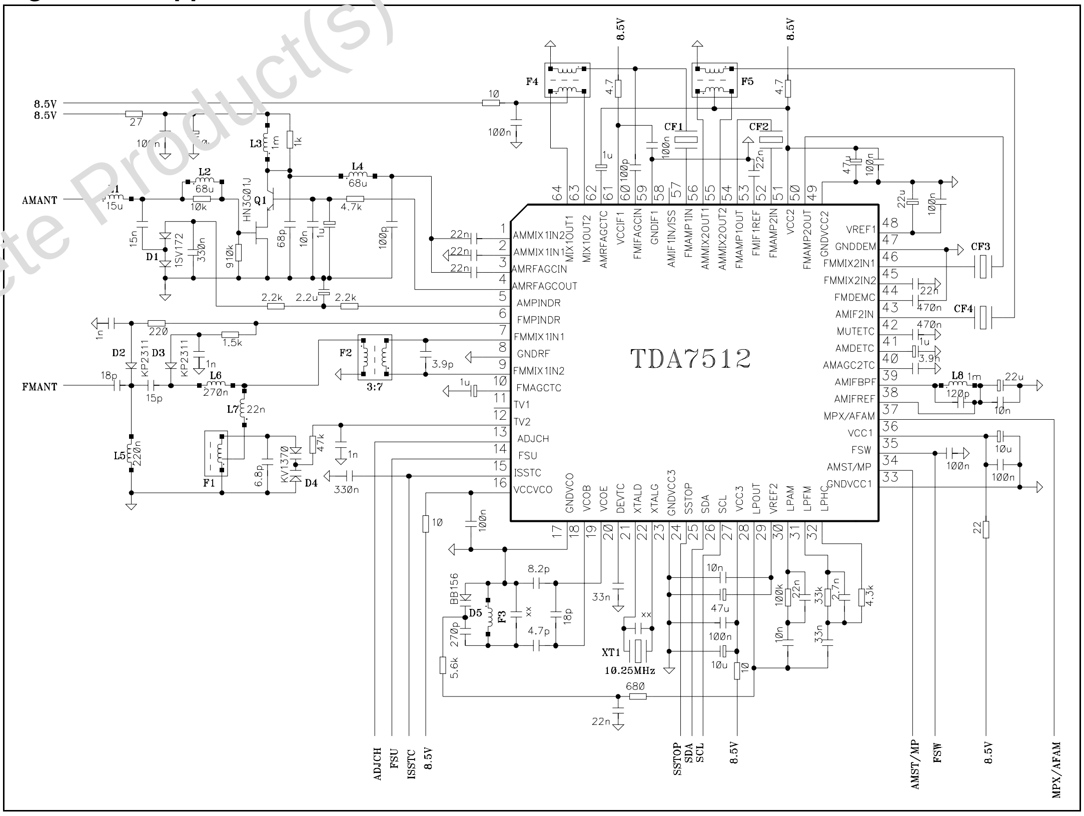
Table 38. Part list (application and measurement circuit)

Item	Description
F1	TOKO 5KG 611SNS-A096GO
F2	TOKO 5KM 396INS-A467AO
F3	TOKO MC152 E558HNA-100092

Table 38. Part list (application and measurement circuit) (continued)

Item	Description
F4	TOKO 7PSG 826AC-A0022EK=S
F5	TOKO PGL 5PGLC-5103N
L1	TOKO FSLM 2520-150 15 µH
L2,L4	TOKO FSLM 2520-680 68 µH
L3,L8	SIEMENS SIMID03 B82432 1 mH
L5	TOKO LL 2012-220
L6	TOKO LL 2012-270
L7	TOKO LL 2012-22.0
CF1,CF2	muRata SFE10.7MS3A10-A 180 kHz or (TOKO CFSK107M3-AE-20X)
CF3	muRata SFE10.7MJA10-A 150 kHz or (TOKO CFSK107M4-AE-20X)
CF4	muRata SFPS 450H 6 kHz or (TOKO ARLFC450T)
D1	TOSHIBA 1SV172
D2,D3	TOKO KP2311E
D4	TOKO KV1370NT
D5	PHILIPS BB156
Q1	TOSHIBA HN3G01J

Figure 9. Application circuit



Appendix B Application notes

Following items are important to get highest performance of TDA7512 in application:

1. In order to avoid leakage current from PLL loop filter input to ground a guardring is recommended around loop filter PIN's with PLL reference voltage potential.
2. Distance between Crystal and VCO input PIN18 should be far as possible and Crystal package should get a shield versus ground.
3. Blocking of VCO supply should be near at PIN16 and PIN17.
4. Wire length to FM mixer1 input and output should be symmetrically and short.
5. FM demodulator capacitance at PIN44 should be sense connected as short as possible versus demodulator ground at PIN47.
6. With respect to THD capacitive coupling from PIN20 to VCO should be avoided. Capacitance at PIN20 has be connected versus VCC2 ground.
7. Wire length from AM mixer tank output to 9 kHz ceramic filter input has to be short as possible.

7 Revision history

Table 39. Document revision history

Date	Revision	Changes
24-Sep-2003	2	Initial release.
11-Dec-2008	3	Document reformatted. Document status promoted from preliminary data to datasheet. Updated *Section 6: Package information on page 42*.
22-Jun-2009	4	Corrected typo (ref: “K” Dim.) on *Figure 4: LQFP64 mechanical data and package dimensions on page 42*.

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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

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- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

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